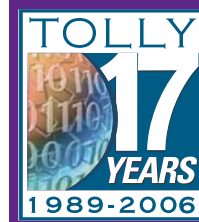


Force10 Networks, Inc.

S-Series S2410 10GbE Switch

10 Gigabit Ethernet Zero-Loss Throughput and Latency Evaluation



Test
Summary

Premise: Several trends are driving the need for low-cost, high-speed aggregation devices within the data center. Consolidation is resulting in more servers clustered in fewer locations. The proliferation of blade servers increases the number of servers within a data center, requiring faster uplinks to the network core. Additionally, the emergence of 10GbE servers is driving the need for greater network speed. In parallel, IP storage and network-attached storage devices also require high-performance 10GbE links.

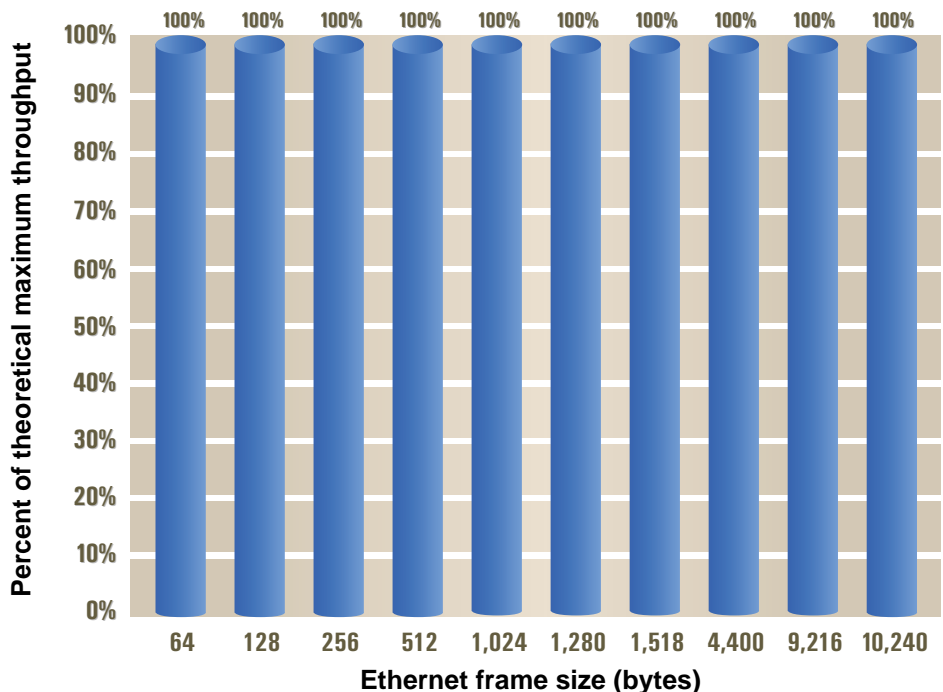
Force10 Networks, Inc. commissioned The Tolly Group to evaluate its S-Series S2410 Switch, a fixed configuration 10 Gigabit Ethernet (10GbE) switch designed to aggregate traditional and blade servers, as well as emerging 10GbE servers and to act as a high-speed interconnect for network-attached storage devices.

Engineers measured the zero-loss 10GbE throughput of the S-Series S2410 to determine the capability of the device to scale zero-loss throughput across a large number of servers. Engineers also recorded the latency introduced by the S2410 when handling 10 different frame sizes ranging from demanding 64-byte frames to 10,240-byte Jumbo Frames. Tests were conducted in March 2006.

Test Highlights

- Achieves 100% of line-rate zero-loss throughput when tested across 24 full-mesh 10GbE ports, when handling more than a dozen frame sizes ranging from 64 bytes to 10,240 bytes
- Sustains 100% zero-loss line rate across 24 10GbE line-rate ports when tested with multiple packet sizes in a snake configuration
- Demonstrates very low latency, on average just 210 ~ 311 nanoseconds, across the 10 frame sizes tested ranging from 64 bytes to 10,240 bytes

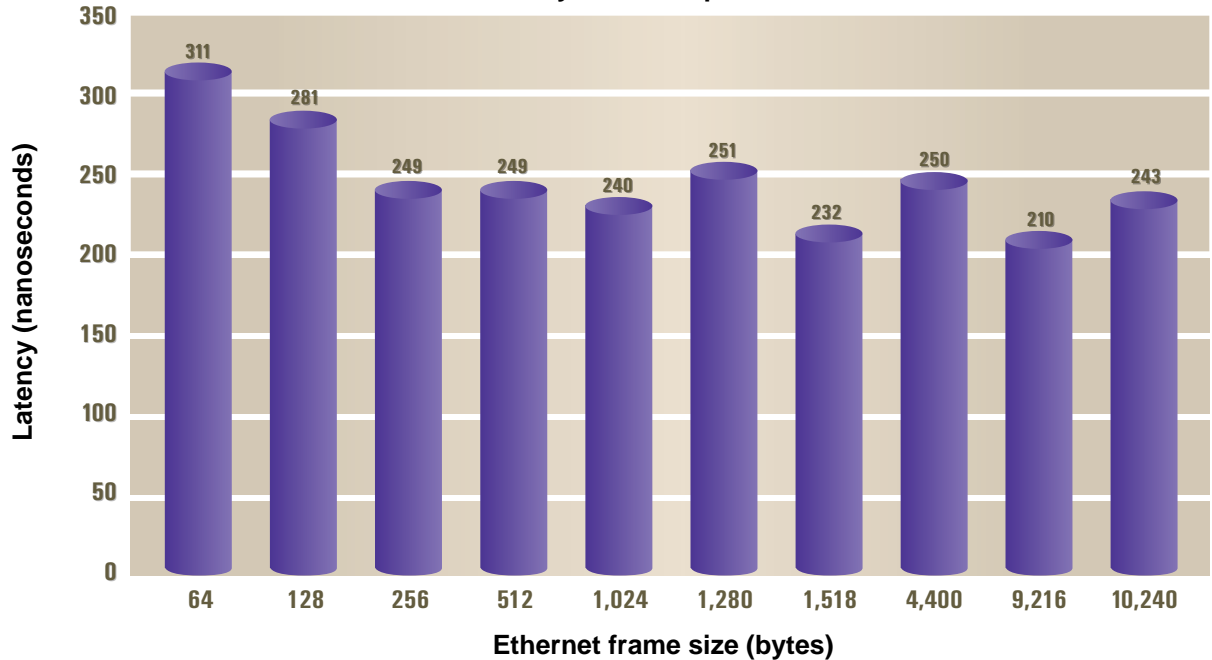
Layer 2 Zero-loss (≤ 0.001) Throughput Across 24 ports in a Full-mesh Configuration as Measured by Ixia IxScriptMate 5.2



Source: The Tolly Group, March 2006

Figure 1

**Force10 S2410 "Segregated" Cut-through Switch Latency
Across 24 ports in a Full-mesh Configuration
as Measured by Ixia IxScriptMate 5.2**



Note: The "segregated" switch latency was calculated by deducting the inherent test tool latency (i.e. latency reported by tool with no DUT) from the latency measured with the DUT connected to the test tool.

Source: The Tolly Group, March 2006

Figure 2

EXECUTIVE SUMMARY

Enterprise network data centers are consolidating operations by pooling greater numbers of traditional and blade-based servers in a single central location. Additionally, the proliferation of IP-based network-attached storage devices, combined with the data center consolidation trend, are driving demand for faster links to connect the data center to the network core. Where Gigabit Ethernet sufficed before, 10GbE is in demand now.

Tolly Group tests show that Force10 Networks' S2410 combines ultra-low latency with high 10GbE performance in a compact, fixed configuration form factor. The S2410 provides the high 10GbE density that data center managers require to connect directly to 10GbE servers or

server racks and then uplink these devices to the core of the network. Additionally, the S2410 delivers the ultra low-latency required for high performance cluster computing – traditionally the domain of Infiniband and other proprietary technologies. Moreover, the familiarity of Ethernet ensures a more manageable solution that requires no new training as organizations move toward a virtualized applications model.

In Layer 2 forwarding performance tests, the S2410 achieved line-rate zero-loss throughput for all 10 frame sizes tested – ranging from 64 bytes to 10,240 bytes. Line-rate performance was realized for both a 10GbE, 24-port full-mesh scenario, and a 24-port snake configuration. When handling an Internet traffic

mix (64, 78, 576 and 1,500 bytes), the S2410 delivered line-rate throughput. Out of 7,280,497,128 frames of Internet-mix traffic transmitted, the S2410 dropped just 1,311 frames, which is equal to 0.000018% of the frame loss rate.

From a frame forwarding perspective, the S2410 forwarded a maximum of 14,880,951 64-byte frames per second for each port, 811,686 frames at 1,518-byte frames per second, and 121,831 frames per second when tested with the maximum frame size of 10,240 bytes.

On the latency front, the S2410 delivered latency ranging from a low of 210 nanoseconds with 9,216-byte frames to 311 nanoseconds with 64-byte frames, or 252 nanoseconds on average across the 10 frame

sizes tested. The S2410 represents the first switch tested by The Tolly Group that delivers nanosecond latencies, as opposed to latency in microseconds more commonly found on other switches. For this test, The Tolly Group took a different approach to report the latency. Usually test tool latency is negligible, but in this case it could have influenced the DUT latency result.

Since the test tool modules reported a relatively high inherent latency numbers (~4 microseconds) when tested back-to-back without the DUT, The Tolly Group deducted these inherent latency numbers from the latency with the DUT directly reported from the test tool to obtain the latency purely associated with the DUT. The Tolly Group has named this as "segregated" switch latency.

When handling an Internet mix of traffic, latency introduced by the switch was just 326 nanoseconds.

The tandem of ultra-low latency and line-rate performance demonstrates that the S2410 will not become a bottleneck to data center servers and will help ensure optimal application response times, especially for latency-sensitive applications.

LAYER 2 FORWARDING THROUGHPUT

24 PORTS, FULL-MESH SCENARIO

For the 10GbE full mesh Layer 2 forwarding throughput test, engineers configured 24 10GbE ports for the S2410 and 24 10GbE ports for the OptIXia X-16. Engineers configured the test suite for bidirectional full-

mesh traffic and configured the test suite to transmit traffic at 64, 128, 256, 512, 1,024, 1,280, 1,518, 4,400, 4,700, 8,000, 9,216 and 10,240 bytes. Engineers ran the zero-loss ($\leq 0.001\%$) throughput test for 60 seconds and recorded the throughput, as well as the latency for each packet size; tests were run three times and the results averaged.

Engineers also subjected the S2410 to an Internet mix traffic stream consisting of 56% 70-byte TCP frames, 22% 1500-byte HTTP frames, 16% 576-byte Telnet traffic and 6% 78-byte UDP frames. The switch delivered line-rate throughput. Even when the Internet mix was reconfigured with a stream consisting of 60% 64-byte TCP frames, 22% 1500-byte HTTP frames, 12% 576-byte Telnet traffic and 6% 78-byte UDP frames, the throughput result remained the same.

24 PORTS, SNAKE TEST SCENARIO

For the 10GbE full snake Layer 2 forwarding throughput test, engineers configured 24 10GbE ports for the S2410 and 24 10GbE ports for the OptIXia X-16. Engineers configured the test suite for bidirectional full "snake" traffic (that is, data exiting on a given port was redirected into an adjacent port) and configured the test suite to transmit traffic at 64, 128, 256, 512, 1,024, 1,280, 1,518, 4,400, 4,700, 8,000, 9,216 and 10,240 bytes. Engineers ran the zero-loss ($\leq 0.001\%$) throughput test for 60 seconds and recorded the throughput as well as the latency for each packet size; tests were run three times and the results averaged.

**Force10
Networks, Inc.**

S-Series S2410

**Throughput
and Latency
Evaluation**



Force10 Networks, Inc. S-Series S2410 Product Specifications*

The S2410 combines the industry's lowest Ethernet latency with industry leading 10GbE density to provide IT managers with more flexible deployment options.

S2410 Key Features

- 24 line-rate 10 GbE ports in a 1-RU form factor
 - 20 CX4 ports with four pluggable XFP or CX4 interfaces
 - 24 XFP interfaces
- 12 link aggregation groups with up to 12 ports per group, using advanced hashing for even traffic distribution
- Hardware-based multicast with support for IGMPv3

Size:

- 17" w x 14" d x 1.73" h (432 x 356 x 44 mm)

Weight:

- 12.0 lbs (5.5 Kg)

Power Supply:

- 100-240V AC, 50-60Hz, Autosensing

Maximum power consumption:

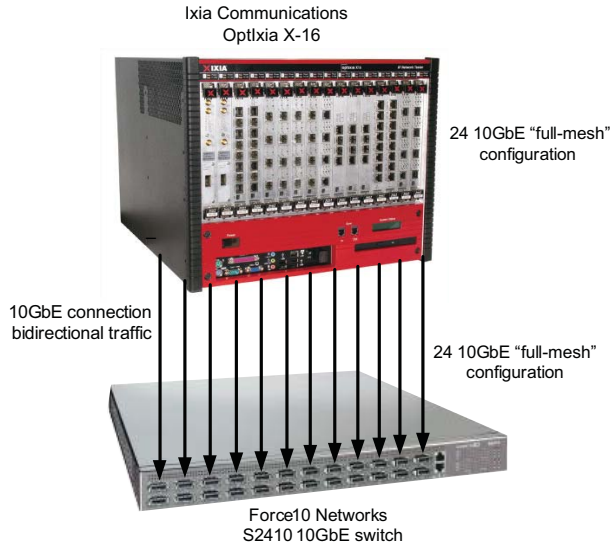
- S2410C: 100W; S2410P: 150W

For more information contact:

Force10 Networks, Inc.
1440 McCarthy Boulevard
Milpitas, CA 95035-7438
Phone: +1 (866) 600-5100
Fax: +1 (408) 571-3550
URL: <http://www.force10networks.com/products/>

**Vendor-supplied information not verified by
The Tolly Group*

Test Bed Diagram



Source: The Tolly Group, March 2006

Figure 3

Engineers also subjected the S2410 to an Internet mix traffic stream consisting of 60% 64-byte TCP frames, 22% 1500-byte HTTP frames, 12% 576-byte Telnet traffic and 6% 78-byte UDP frames.



The Tolly Group gratefully acknowledges the providers of test equipment used in this project.

Vendor	Product	Web address
Ixia Communications	Optixia X-16	http://www.ixiacom.com
Ixia Communications	LM10G1-01	http://www.ixiacom.com
Ixia Communications	IxScriptMate 5.2	http://www.ixiacom.com

TERMS OF USAGE

USE THIS DOCUMENT ONLY IF YOU AGREE TO THE TERMS LISTED HEREIN.

This document is provided, free-of-charge, to help you understand whether a given product, technology or service merits additional investigation for your particular needs. Any decision to purchase must be based on your own assessment of suitability.

This evaluation was focused on illustrating specific features and/or performance of the product(s) and was conducted under controlled, laboratory conditions and certain tests may have been tailored to reflect performance under ideal conditions; performance may vary under real-world conditions. Users should run tests based on their own real-world scenarios to validate performance for their own networks. Commercially reasonable efforts were made to ensure the accuracy of the data contained herein but errors and/or oversights can occur.

The test/audit documented herein may also rely on various test tools the accuracy of which is beyond our control. Furthermore, the document relies on certain representations by the sponsor that are beyond our control to verify. Among these is that the software/hardware tested is production or production track and is, or will be, available in equivalent or better form to commercial customers.

The Tolly Group provides a fee-based service to assist users in understanding the applicability of a given test scenario to their specific needs. Contact us for information.

When foreign translations exist, the English document is considered authoritative. To assure accuracy, only use documents downloaded directly from The Tolly Group's Web site.

PROJECT PROFILE

Sponsor: Force10 Networks, Inc.

Document number: 206116

Product class: Aggregation switch/router

Products under test:

- S-Series S2410 Switch SW Version 1.1.2 Beta (GA Version 2.3.1)

Testing window: March 2006

Software status:

- Generally available

For more information on this document, or other services offered by The Tolly Group, visit our World Wide Web site at <http://www.tolly.com>, send E-mail to sales@tolly.com, call (561) 391-5610.

Information technology is an area of rapid growth and constant change. The Tolly Group conducts engineering-caliber testing in an effort to provide the interworking industry with valuable information on current products and technology. While great care is taken to assure utmost accuracy, mistakes can occur. In no event shall The Tolly Group be liable for damages of any kind including direct, indirect, special, incidental, and consequential damages which may result from the use of information contained in this document. All trademarks are the property of their respective owners.

The Tolly Group doc. 206116 rev. clk 20 Mar 06